I. C. 6751 DECEMBER, 1933

UNITED STATES BUREAU OF MINES
SCOTT TURNER, DIRECTOR

INFORMATION CIRCULAR

JAN

ONYX MARBLE AND TRAVERTINE

BY

OLIVER BOWLES AND D. M. BANKS

Generated on 2024-09-17 14:37 GMT / https://hdl.handle.net/2027/osu.32435030644116
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

I.C. 6751
December, 1933.

INFORMATION CIRCULAR

UNITED STATES BUREAU OF MINES

ONYX MARBLE AND TRAVERTINE[1]

By Oliver Bowles[2] and D. M. Banks[3]

CONTENTS

	Page		Page
Introduction	2	United States--Cont'd.	
Origin and character	2	New Mexico	6
Onyx marble	3	South Dakota	6
Occurrence	3	Utah	6
Foreign countries	3	Other States	6
Mexico	3	Uses	6
Argentina	4	Production and imports	7
Chile	4	Prices	8
France	4	Travertine	8
Germany	4	Occurrence	8
Italy	4	Italy	8
Spain	4	California	9
Algeria	4	Colorado	9
Egypt	4	Florida	10
Persia	4	Georgia	10
United States	5	Montana	10
Arizona	5	Other States	10
California	5	Uses	10
Montana	5	Production and imports	11

1 The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is used: "Reprinted from U. S. Bureau of Mines Information Circular 6751."

2 Supervising engineer, building materials section, U. S. Bureau of Mines.
3 Building materials section, U. S. Bureau of Mines.

Generated on 2024-09-17 14:42 GMT / https://hdl.handle.net/2027/osu.32435030644116
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

INTRODUCTION

Calcareous rocks are used extensively for building and ornamental purposes. The principal varieties are marble and limestone. Onyx and travertine are subdivisions of these groups that are sufficiently distinctive in origin and use to merit separate classification. The purpose of this paper is to define the terms "onyx" and "travertine" and to describe the occurrences and uses of the materials bearing these names.

ORIGIN AND CHARACTER

Confusion exists in the use of the word "onyx." True onyx is a banded chalcedony, a form of silicon dioxide related to jasper, agate, and flint. Calcium carbonate is commonly deposited from solution in successive layers of varying color closely resembling onyx, and for this reason such calcareous rock is also called "onyx." To distinguish the calcareous from the siliceous varieties, the former is called "onyx marble." It is sometimes designated "Mexican onyx" because famous deposits are situated in Mexico.

Onyx marble and travertine are described together because they are of similar origin. Calcium carbonate is practically insoluble in pure water but is soluble to some extent in water charged with carbon dioxide. Thus, carbonated springs may carry calcareous solutions. When they reach the surface the carbon dioxide is dissipated in the atmosphere, and, the solvent being lost, the calcium carbonate is deposited. Many deposits are found to consist of aragonite rather than calcite. Impurities, such as iron and manganese oxides, in the solution may vary during deposition from time to time, and consequently successive layers may be of different colors.

Onyx marble is regarded generally as a deposit from cold-water solutions. It may be formed at the surface of the earth around exits of springs or in rifts, cracks, or cavities in the rock through which the solution flows. Deposits may also take the form of stalactites, stalagmites, and surface coatings in limestone caves. For this reason the mineral sometimes is called "cave onyx." Onyx takes a high polish and, therefore, is classed with the marbles. Its translucence and attractive banding fit it for highly decorative uses.

Travertine originates in much the same way as onyx, but it is regarded as a product of precipitation from hot springs. Sometimes deposition takes place on the bottoms of shallow pools where the rate of escape of the carbon dioxide gas is retarded sufficiently to permit the material to assume a compact and crystalline texture. Travertine is characterized by the presence of numerous irregular cavities varying from the size of a pin's head, or smaller, to a half inch or more across. Most travertines are not susceptible of high polish and therefore are classed with the limestones rather than with the marbles. A variety too soft and porous for building purposes is known as "calcareous tufa," and deposits of fine unconsolidated particles mixed with clay and other impurities are termed "marl."

Generated on 2024-09-17 14:43 GMT / https://hdl.handle.net/2027/osu.32435030644116
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

ONYX MARBLE

Occurrence

Onyx marbles occur in many limestone districts of the United States and foreign countries, but only a few localities produce material of a quality and quantity to justify commercial production. The deposits now producing or that are noteworthy are here described.

Foreign Countries

Mexico.--The Mexican onyx deposits are the most important commercially at the present time. The quarries, known as the New Pedrara, are at El Marmol, Lower California, 51 miles inland from Santa Catarina, the port of shipment, and about 330 miles southeast of San Diego, Calif. The largest of them are on a mesa about 40 feet high, 3,000 feet long, and 1,200 feet wide. Commercial onyx occurs in three beds. The upper bed is thin and highly colored and provides relatively small masses suitable for novelty work such as automobile gear-shift balls, pen bases, lamp fittings, ash trays, book ends, and candlesticks. The second bed is 1 to 2 feet thick and furnishes both novelty and block onyx, and the third or lowest stratum supplies large blocks ranging from 1 to 4 feet in thickness that may be cut into sound slabs for decorative uses in banks, theaters, and hotel lobbies. Explosives are used only in stripping, and blocks are separated in the quarry by plug-and-feather wedging. Annual production is about 25,000 cubic feet, and a reserve of 1,500,000 cubic feet is said to be in sight. However, production has been much smaller since 1930.

The most difficult problem is transportation, for blocks must be hauled in 5-ton trucks with trailers 51 miles to Santa Catarina where storage yards are maintained. Stiff-leg derricks on a 400-foot wharf load the blocks on lighters which carry them to ships lying beyond the breakers. From there they are conveyed to San Diego where they are manufactured into finished products or held in bonded yards for shipment to many countries.

The Mexican product is very beautiful owing to its translucency, freedom from flaws, and fine color banding. The colors are peculiarly delicate, and the quality is remarkably uniform. Light greens, pearl white, and delicate rose are the more common colors, all variegated by a network of fine sharp veins of rose red.

Other districts in Mexico have produced onyx, but the deposits are not commercially important at present. A quarry near the city of Puebla, the famous La Pedrara, many years ago furnished a fine quality of green onyx ranging from a very light to a very dark tint showing a slight dash of red or pink. The high reputation of this stone was recognized the world over.

Three quarries of some importance in the vicinity of Tehuacan, Puebla, have furnished onyx of variegated colors and of pure white.

Generated on 2024-09-17 14:39 GMT / https://hdl.handle.net/2027/osu.32435030644116
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

From several quarries on the Tequisistlan River northwest of Salina Cruz in Oaxaca onyx of excellent quality was exported to the United States for a number of years, but owing to poor methods of cutting the blocks and to competition with the cheaper onyx from Lower California the industry did not prosper.

Argentina.--Translucent onyx marble with attractive green, brown, and red veins occurs at several points in Argentina. It is sometimes called "Brazilian onyx." A small amount of the exports from this country now reaches the American market.

Chile.--Onyx production has been reported from the province of Atacama, Chile.

France.--Onyx marbles in France are confined to the slopes of the Pyrenees. The most noteworthy is "Stalactite du Bedat," quarried at Hautes-Pyrenees.

Germany.--In Hanover, Germany, an onyxlike mineral locally called "onysette" is being worked in a small way to produce blocks which are manufactured in Germany and Holland.

Italy.--Many localities capable of affording fine onyx marble exist in different parts of Italy. Yellow, white, and dark-brown varieties have been quarried in the Provinces of Cuneo, Como, Bergamo, and Vrescia. The Appennine Range has furnished a great deal of material for the churches and palaces of Italy.

Spain.--In Spain a wax-yellow onyx occurs in caverns at Malaga, and white and green varieties at Arcenia in Andalusia.

Algeria.--Celebrated deposits of onyx occur in the northern part of Algeria in the Province of Oran. These deposits were important sources of supply for the Romans. The stone varies greatly in color and shade, ranging from pure white to rose, bright red, golden yellow, and, more rarely, green.

Egypt.--Egypt was one of the most important sources of onyx marble in ancient times. Unlike that of Algeria the product is a stalagmitic type. Many deposits were worked in the Nile Valley as early as the time of the First Dynasty, but most of them have been worked out or have been abandoned for other reasons. Recent supplies have been obtained from near the town of Assuit, the site of ancient Lycopolis.

Persia.--Deposits in Persia which furnished the beautiful onyx found in the old buildings and tombs of that country were located near Tabriz on the eastern shore of Lake Croomiah and in the mountains near Yezd. The stone is of a pink, greenish, or milk-white color, streaked with reddish or copper-colored veins.

Generated on 2024-09-17 14:38 GMT / https://hdl.handle.net/2027/osu.32435030644116
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

United States

Arizona.--Several deposits of onyx marble of commercial importance are known in the United States. A deposit that has been operated periodically for 40 years is at Mayer in Yavapai County, Ariz., 15 miles southeast of Prescott. About 10 quarries have been operated within the past few years.

The deposit varies in thickness from a few inches to 25 feet and covers an area of about a square mile. It consists of bedded calcite and aragonite beautifully colored by iron oxides. Onyx in a great variety of colors is obtainable. The green variety with dashes of red and brown known as "Paisley shawl" is a compact highly lustrous stone and is especially desirable. The onyx is quarried in large slabs and shipped to a finishing plant at Dyersville, Iowa.

Deposits in the extreme southern part of the State in Maricopa County on Camp Creek west of Cave Creek are also quarried. They consist of boulders of calcite and aragonite in soft travertine. The prevailing colors are green and yellow with veins of brown and red. The boulders are cemented together with plaster of paris, sawed into blocks, and then polished at the finishing plant of the company located at Phoenix.

A deposit in Santa Cruz County about 4½ miles south of Greaterville, Prince County, is reported to consist of material so free from cracks that the size of blocks obtainable is limited only by the equipment that may be installed to handle the stone and by transportation facilities. It comes in brown of various shades.

California.--Quite a number of deposits of onyx marble in California have been reported, but most of them are too small to be of commercial importance.

A quarry at Suisun City in Solano County, which has recently been producing, furnishes a stone varying from light amber to deep resinous brown.

A light-brown beautifully veined variety has been reported also from San Bernardino County.

A deposit which furnished material in considerable quantities about 25 years ago is located in San Luis Obispo County near Musick. The colors of this deposit are quite variable. The stone is close in texture, is translucent, and takes a high polish. Blocks 3 to 6 feet square were taken from the quarries. Specimens of the material are on exhibit in the Museum of the California State Mining Bureau.

A small deposit of a rich deep-brown color with veins of lighter yellowish brown has been worked on Sulphur Creek, Colusa County.

Montana.--A vein of onyx 65 feet wide occurring about 5 miles north of Manhattan, Gallatin County, has been developed to some extent. A silicified banded ornamental rock, known locally as "Montana onyx", occurs near Virginia City, Madison County.

Generated on 2024-09-17 14:44 GMT / https://hdl.handle.net/2027/osu.32435030644116
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

New Mexico.--Onyx marble has been produced near Rio Puerco in Valencia County, N. Mex.

South Dakota.--A deposit estimated to be 300 feet wide and 1,500 feet long is reported in the Black Hills of South Dakota near Custer.

Utah.--In Utah quarrying has taken place at Pelican Point on the west shore of Utah Lake. The stone of dark and light amber shades has been described as being beautifully translucent and with colors of great depth and brilliancy. It was used in the interior of the City and County Building, Salt Lake City. A deposit at Lehi in the same county furnished bright lemon and orange, dark buff, chrome yellow, and white slabs.

A deposit in Tooele County ranging in width up to 300 feet and in length to 4,500 feet also has been quarried. The colors of the material range from flaky whites through creams, pinks, and lavenders to yellows shaded with brown. The stone was used in the State Capitol in Salt Lake City.

Other States.--Onyx marbles also occur in the Eastern Appalachian region of the United States, especially in the cave districts of Virginia. It has sometimes happened that these deposits are of sufficient extent to warrant the opening of small quarries, though the stone is rarely of sufficient beauty to enter into active competition with the onyx marbles of Mexico, Arizona, and California. A quarry was at one time developed at Willowton, W. Va., and produced material of a greenish-white color similar to the Mexican onyx.

Several cave deposits in the vicinity of Cave City and Mammoth Cave, Ky., yielded small quantities of material for a number of years. Quarries in the broken-down caves of eastern Tennessee, southwestern Missouri, and Arkansas also have been opened and worked for a limited period, some of which furnished a fair grade of material.

Uses

Onyx marble at present is used principally for interior decoration and for novelties. In the gift-shop trade small pieces may be found in the form of ink stands, lamp bases, smoking sets, clock cases, paper weights, card receivers, and plaques. Table tops and other pieces of furniture are sometimes made of onyx. A prominent use is for gear-shift balls. Larger sizes are employed in staircases, for mantels and fireplaces, or as moldings or columns; large slabs are used for ornamental wainscoting in hotel lobbies, banks, and theaters, and also as panels fronting soda fountains. One writer has deplored the fact that so beautiful a stone is used in modern times largely for flat surfaces only, all brilliantly polished, "yet the stone will cut to as sharp an edge as the finest Carrara marble and is eminently adapted for bas-relief, small statues, busts, and objects of like nature."

In Egypt during very early times onyx marbles were used for making small articles such as jugs, bowls, vases, and urns of different shapes and designs. These were used for domestic purposes and also in religious rites. Few, if

Generated on 2024-09-17 14:37 GMT / https://hdl.handle.net/2027/osu.32435030644116
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

any, of these articles were polished, though many show great skill in workmanship. Statuettes of that period carved from onyx may be found in museums. This type of marble, which was available in slabs 20 feet long, was used also for the decoration of tombs and temples and for construction of shrines. Large blocks or columns of the material were also used in buildings. One of the finest pieces of work now on exhibition in a museum in London is an elaborately carved sarcophagus hollowed out of a single piece of onyx marble.

The stone was used by the Romans in much the same way. In an Arabian mosque built during the twelfth century was found the remains of an old court flagged with onyx. References are made to the use of onyx "in the palmy days of the Persian empire" in the form of slabs to pave fountains and baths. Small pieces were used in windows and doors instead of glass.

Onyx marble was quarried in Mexico before the time of the Spaniards. The Aztecs used it extensively in the ornamentation of their temples; altars and baptismal fonts were made of it; thin slabs constituted the window panes.

Production and Imports

So little onyx marble is quarried in the United States that it has never been possible to publish figures of production separate from those of marble. The amount produced never has been large.

Import figures likewise are not reported separately. Marble, breccia, and onyx are combined in the statistical reports, and as marble constitutes by far the largest proportion of the tonnage imported it is impossible to determine the amount from any country except Mexico. Recent marble imports from that country, all of which may be regarded as onyx marble, are shown in the following table.

Onyx marble (rough and manufactures) imported into the United States from Mexico. 1920-31

Year	Rough onyx		Manufactures, value	Total value
	Cubic feet	Value		
1920	7,846	$43,878	$173	$44,051
1921	2,245	9,191	137	9,328
1922	6,550	37,020	5	37,025
1923	5,349	24,933	.....	24,933
1924	5,506	19,917	602	20,519
1925	2,767	16,163	.....	16,163
1926	16,270	72,389	383	72,772
1927	26,509	96,062	2,264	98,326
1928	24,631	97,855	114	97,969
1929	18,687	76,889	1,277	78,166
1930	17,203	69,120	724	69,844
1931	1,475	12,000	69	12,069

Generated on 2024-09-17 14:38 GMT / https://hdl.handle.net/2027/osu.32435030644116
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

The Tariff Act of 1930 provides duties on onyx and manufactures of onyx imported for consumption in the United States under paragraph 232, as follows:

(a) Marble, breccia, and onyx, in block, rough or squared, only, 65 cents per cubic foot; marble, breccia, and onyx, sawed or dressed, over two inches in thickness, $1 per cubic foot.

(b) Slabs and paving tiles of marble, breccia, or onyx; containing not less than four superficial inches, if not more than 1 inch in thickness, 8 cents per superficial foot; if more than 1 inch and not more than 1½ inches in thickness, 10 cents per superficial foot; if more than 1½ inches and not more than 2 inches in thickness, 13 cents per superficial foot; in addition thereto on all the foregoing, if rubbed in whole or in part, 3 cents per superficial foot, or if polished in part (whether or not rubbed), 6 cents per superficial foot.

(c) Mosaic cubes of marble, breccia, or onyx, not exceeding 2 cubic inches in size, if loose, one-fourth of 1 cent per pound and 20 per centum ad valorem; if attached to paper or other material, 5 cents per superficial foot and 35 per centum ad valorem.

(d) Marble, breccia, and onyx, wholly or partly manufactured into monuments, benches, vases, and other articles, and articles of which these substances or any of them is the component material of chief value, not specially provided for, 50 per centum ad valorem.

Prices

As onyx is ornamental in character and quite variable in quality there are no standard methods of grading and no regular market quotations. The price varies with the quality and with the size of solid blocks. An onyx that might be worth $5 a cubic foot in small pieces might be worth $25 or $30 a cubic foot if available in large solid masses.

TRAVERTINE

Occurrence

Travertine deposits large enough to supply blocks of commercial size are uncommon. Italy has been the chief source of production and has supplied the entire requirements of the United States until the last few years, during which time several deposits in this country have been developed. The Italian and domestic deposits are described briefly.

Italy.--Travertine appears to have been used in Italy as early as the second century B.C. and was employed at first only for ornamental purposes. It was later employed widely as a building stone.

The principal source of supply of travertine has been from the deposits at Tivoli about 16 miles east of Rome. Del Barco near the famous baths of

Generated on 2024-09-17 14:42 GMT / https://hdl.handle.net/2027/osu.32435030644116
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Acque Albule at Bagni, a railway station between Rome and Tivoli, is one of the oldest quarries. It furnished travertine during the days of the Roman Empire.

For several centuries the method of block separation at these quarries was by a slow process of cutting hand-picked channels on four sides and then sedging up at the floor. The stone is now cut with wire saws into blocks about 10 meters long, 1 meter thick, and 2 to 3 meters high. It has been reported that blocks can be put on cars at Bagni at a cost of about 350 lire a cubic meter and on board trans-Atlantic ships for about 400 lire. In 1929, the time of this estimate, 19 lire were equivalent to about $1. The above costs, therefore, were respectively about 66 and 71 cents a cubic foot. Rock at the western end of the quarry is variegated gray and white, stained in places with iron oxide. During recent years this type has become more popular, whereas formerly the only kind used was the more regularly colored rock at the eastern end of the quarry.

The available travertine area is extensive, and several quarries other than the one described are worked. St Peters, the greatest cathedral in the world, and the famous Colosseum, the largest theater, begun by Vespasian in A.D. 75 and dedicated by Titus in A.D. 80, were built chiefly of travertine from the Tivoli quarries. During the fifteenth and sixteenth centuries the Colosseum was treated as a quarry where stone was procured for many churches and palaces in Italy, notably the Palazzo di San Marco in Venice and the historic Palazzo Farnese in Rome. Demolition was finally stopped, and the structure partly restored.

During recent years large quantities of Italian travertine have been imported for interior decorative and structural uses in America. The Pisani quarry, not far from the Del Barco, supplied travertine for the Pennsylvania Railway Station in New York, a structure which attracted much attention and popularized the use of Italian travertine in this country.

California.--An old deposit in California, which had formerly furnished what was regarded as marble for buildings in San Francisco, was again operated in 1929. The quarry is located near the town of Bridgeport in Mono County. The stone comes in a variety of colors; some of it varying from clear white to pale yellow and gray is said to be of the same texture and quality as the best Roman travertine. There are also orange, pink, red, and brown colors.

Colorado.--A deposit that compares favorably with the famous Italian travertine has been developed about 6 miles east of Salida, Colo., near the Denver & Rio Grande Western Railway. The deposit forms one side of a mountain which rises 250 feet from the valley floor. The exposure is 1,300 feet long and 200 feet thick. The stone is light buff in color, very attractive in appearance, and is finding wide use in the cities of this country for both interior and exterior building.

Two other travertine quarries have been opened recently in Colorado, one near Salida in Chaffee County and one near Canon City in Fremont County. Production up to 1931 was confined to terrazzo.

Generated on 2024-09-17 14:40 GMT / https://hdl.handle.net/2027/osu.32435030644116
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Production and Imports

Production figures of travertine are included with those of limestone in the statistical reports of the Bureau and therefore cannot be shown separately. An increase in the production units of travertine would indicate a growing demand for this product.

Travertine was not separated from other stone imports prior to 1930. It has been brought out in tariff hearings that imports normally amount to about 100,000 cubic feet a year and that the material sells in New York at about $2.25 a cubic foot. The chief markets are in the large Eastern Cities.

Generated on 2024-09-17 14:43 GMT / https://hdl.handle.net/2027/osu.32435030644116
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

Digitized by Google

Original from
THE OHIO STATE UNIVERSITY

I. C. 6751R
(Revision of I. C. 6751
published December 1933)

June 1940

UNITED STATES
DEPARTMENT OF THE INTERIOR
Harold L. Ickes, Secretary

BUREAU OF MINES
R. R. Sayers, Acting Director

INFORMATION CIRCULAR

ONYX MARBLE AND TRAVERTINE

RECEIVED
JUL 5 1940
U.S. DEPT. OF INT.

BY

Oliver Bowles

After this report has served your purpose and if you have no further need for it, please return it to the Bureau of Mines, using the official mailing label on the inside of the back cover.

Generated on 2024-09-17 14:40 GMT / https://hdl.handle.net/2027/osu.32435030644116
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

Digitized by Google

Original from
THE OHIO STATE UNIVERSITY

I. C. 6751R, June 1940.
(Revision of I. C. 6751
published December 1933.)

INFORMATION CIRCULAR

UNITED STATES DEPARTMENT OF THE INTERIOR - BUREAU OF MINES

ONYX MARBLE AND TRAVERTINE[1]

By Oliver Bowles[2]

CONTENTS

	Page
Introduction	1
Origin and character	1
Onyx marble	2
Occurrence	2
Foreign countries	3
United States	5
Uses	7
Production and imports	7
Prices	8
Travertine	9
Occurrence	9
Foreign countries	9
United States	10
Uses	10
Production and imports	11

INTRODUCTION

Calcareous rocks, of which the principal varieties are marble and limestone, are used extensively for building and ornamental purposes. Onyx and travertine, subdivisions of these groups, are sufficiently distinctive in origin and use to merit separate classification. The purpose of this paper is to define the terms "onyx" and "travertine" and to describe the occurrences and uses of the materials bearing these names.

ORIGIN AND CHARACTER

Confusion exists in the use of the word "onyx." True onyx is a banded chalcedony, a form of silicon dioxide related to jasper, agate, and flint. Calcium carbonate is commonly deposited from solution in successive layers of varying color closely resembling onyx, and for this reason such calcareous rock is also called "onyx." To distinguish the calcareous from the siliceous

1/ The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is used: "Reprinted from Bureau of Mines Information Circular 6751R."

2/ Assistant chief engineer, Nonmetal Economics Division, Bureau of Mines.

Generated on 2024-09-17 14:40 GMT / https://hdl.handle.net/2027/osu.32435030644116
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

varieties, the former is called "onyx marble." It is sometimes designated "Mexican onyx" because famous deposits are situated in Mexico.

Onyx marble and travertine are described together because they are of similar origin. Calcium carbonate is very slowly soluble in pure water but is much more soluble in water charged with carbon dioxide. Thus, carbonated springs may carry calcareous solutions. When they reach the surface the carbon dioxide is dissipated in the atmosphere, therefore, the calcium carbonate is deposited. Many deposits are found to consist of aragonite rather than calcite. Impurities in the solution, such as iron and manganese oxides, may vary from time to time during deposition, consequently the colors of successive layers may be different.

Onyx marble is regarded generally as a deposit from cold-water solutions. It may be formed at the surface of the earth around exits of springs or in rifts, cracks, or cavities in the rock through which the solution flows. Deposits may also take the form of stalactites, stalagmites, and surface coatings in limestone caves. For this reason the mineral sometimes is called "cave onyx." Onyx takes a high polish, therefore it is classed with the marbles. Its translucence and attractive banding fit it for highly decorative uses.

Travertine originates in much the same way as onyx, but it is regarded as a product of precipitation from hot springs. Sometimes deposition takes place on the bottomsof shallow pools where the rate of escape of the carbon dioxide gas is retarded sufficiently to permit the material to assume a compact and crystalline texture. Travertine is characterized by numerous irregular cavities which range in size from a pinhead or smaller to a half inch or more across. Most travertines are not susceptible of high polish, therefore they are classed with the limestones rather than with the marbles. A variety too soft and porous for building purposes is known as "calcareous tufa," and deposits of fine unconsolidated particles mixed with clay and other impurities are termed "marl."

Some varieties of stone classed as travertine take a good polish, and the question may arise as to whether they should be regarded as travertine or onyx marble. Ordinarily calcareous rocks capable of a good polish are classed as marbles, but it seems desirable to include with travertine and classify as limestone all material having the characteristic cavities or holes irrespective of whether it may be polished.

ONYX MARBLE

Occurrence

Onyx marbles occur in many limestone districts of the United States and foreigh countries, but only a few localities yield material of such quality and quantity as to justify commercial production. Producing or noteworthy deposits are described herein.

Generated on 2024-09-17 14:42 GMT / https://hdl.handle.net/2027/osu.32435030644116
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Foreign Countries

Mexico. - The Mexican onyx deposits are the most important commercially at present. The quarries, known as the New Pedrara, operated by the New Pedrara Onyx Co., are at El Marmol, Lower California, 51 miles inland from Santa Catarina, the port of shipment, and about 330 miles southeast of San Diego, Calif. The largest of them are on a mesa about 40 feet high, 3,000 feet long, and 1,200 feet wide. Commercial onyx occurs in three beds. The upper bed is thin and highly colored and provides relatively small masses suitable for novelty work such as automobile gearshift balls, pen bases, lamp fittings, ashtrays, book ends, and candlesticks. The second bed is 1 to 2 feet thick and furnishes both novelty and block onyx, and the third or lowest stratum supplies large blocks ranging from 1 to 4 feet in thickness that may be cut into sound slabs for decorative uses in banks, theaters, and hotel lobbies. Explosives are used only in stripping, and blocks are separated in the quarry by plug-and-feather wedging. Annual production is 10,000 to 15,000 cubic feet, and a reserve of 1,500,000 cubic feet is said to be in sight. The quarry blocks are handled by the Southwest Onyx & Marble Co., San Diego, Calif.

The most difficult problem is transportation, as blocks must be hauled in 5-ton trucks with trailers 51 miles to Santa Catarina where storage yards are maintained. Stiff-leg derricks on a 400-foot wharf load the blocks on lighters which carry them to ships lying beyond the breakers. From there they are conveyed to San Diego where they are manufactured into finished products or held in bonded yards for shipment to many countries.

The Mexican product is very beautiful owing to its translucency, freedom from flaws, and fine color banding. The colors are peculiarly delicate, and the quality is remarkably uniform. Light greens, pearl white, and delicate rose are the more common colors, all variegated by a network of fine sharp veins of rose red.

Another interesting deposit of onyx marble is situated about 150 miles south of El Marmol at El Marmolito. It is somewhat smaller than the deposit at El Marmol but has the advantage of being only 11 miles from Miller's Landing on the coast. The rock is a very attractive white, light-green, medium-green, and rose-green onyx. The Cia Minera C. A. Friz S. A. Ensanada, Lower California, Mexico, was organized in 1939 to operate the quarries. The product is sold under the trade name "Yaqui onyx."

Other districts in Mexico have produced onyx. A quarry near the city of Puebla, the famous La Pedrara, many years ago furnished a fine quality of green onyx ranging from a very light to a very dark tint showing a slight dash of red or pink. The high reputation of this stone was recognized throughout the world.

Three quarries of some importance in the vicinity of Tehuacan, Puebla, have furnished onyx of variegated colors and of pure white.

Generated on 2024-09-17 14:42 GMT / https://hdl.handle.net/2027/osu.32435030644116
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

The Etla quarries north of Oaxaca in Oaxaca Province produce small quantities of green, white, and gray onyx and still smaller quantities of medium green and light brown onyx. The shipping point is Magdalena, and the product is exported from Vera Cruz.

Shipping rates in 1939 were $8 a ton from Vera Cruz, Mexico, to New York, N. Y., and $11 a ton from Los Angeles to New York via the Panama Canal.

Argentina. - A very attractive, translucent, dark-green onyx marble sold under the trade name "Brazilian onyx" is quarried by the C. A. Friz Co. (Buenos Aires) at Santa Isabel, Province of San Luis. From 2,000 to 4,000 cubic feet are shipped annually to the United States, chiefly for the manufacture of novelties. The quarry blocks are handled by the C. A. Friz Corporation, New York, N. Y.

Small quantities of white and light green onyx are quarried at San Rafael, Province of Mendoza. It is sold under the trade name "San Rafael onyx."

The shipping rate from Buenos Aires to New York was $5 to $10 a ton, depending upon block size, until war broke out in Europe late in 1939, after which the rate was advanced to $8 to $16 a ton.

Chile. - Production of onyx has been reported from the Province of Atacama, Chile.

France. - Onyx marbles in France are confined to the slopes of the Pyrenees. The most noteworthy is "Stalactite du Bedat," quarried at Hautes-Pyrenees.

Germany. - In Hanover, Germany, a deposit of an onyxlike mineral locally called "onysette" is being worked to a small extent to produce blocks which are manufactured in Germany and Holland.

Italy. - Many localities in different parts of Italy are capable of yielding fine onyx marble. Yellow, white, and dark-brown varieties have been quarried in the Provinces of Cuneo, Como, Bergamo, and Vrescia. The Appennine Range has furnished much material for the churches and palaces of Italy.

Spain. - In Spain a wax-yellow onyx occurs in caverns at Malaga and white and green varieties at Arcenia in Andalusia.

Algeria. - The deposits of onyx in the northern part of Algeria in the Province of Oran are celebrated and were important sources of supply for the Romans. The stone varies greatly in color and shade, ranging from pure white to rose, bright red, golden yellow, and, more rarely, green. At present the onyx is shipped chiefly to France where it is sold as "Algerian onyx."

Egypt. - Egypt was one of the most important sources of onyx marble in ancient times. The product, unlike that of Algeria, is a stalagmitic type. Many deposits were worked in the Nile Valley as early as the First Dynasty,

Generated on 2024-09-17 14:45 GMT / https://hdl.handle.net/2027/osu.32435030644116
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

but most of them have been worked out or abandoned for other reasons. Recent supplies have come from near the town of Assuit, the site of ancient Lycopolis.

Persia. - Deposits in Persia which furnished the beautiful onyx found in the old buildings and tombs of that country were located near Tabriz on the eastern shore of Lake Oroomiah and in the mountains near Yezd. The stone is of a pink, greenish, or milk-white color, streaked with reddish or copper-colored veins.

Yugoslavia. - It was reported in 1936 that blocks of clear onyx marble ranging in weight from 100 to 1,000 kilograms (220 to 2,200 pounds) were obtained from a large deposit at Tetovo in southern Yugoslavia.

United States

Arizona. - A deposit of onyx marble has been operated periodically for many years at Mayer in Yavapai County, Ariz., 15 miles southeast of Prescott.

The deposit ranges in thickness from a few inches to 25 feet and covers an area of about 1 square mile. It consists of bedded calcite and aragonite beautifully colored by iron oxides. Onyx in a great variety of colors is obtainable. The green variety with dashes of red and brown known as "Paisley shawl" is a compact highly lustrous stone and is especially desirable. The onyx has been quarried at times by the National Marble Co. of Omaha, Nebr., and shipped to a finishing plant at Dyersville, Iowa. It is reported that both quarry and mill ceased operation at the end of 1939.

A deposit of onyx marble in the vicinity of Cave Creek in northern Maricopa County, 55 miles northeast of Phoenix, comprises boulders of calcite and aragonite in soft travertine. The prevailing colors are green and yellow with veins of brown and red. Considerable quantities of highly ornamental onyx used for novelty manufacture are produced by the Arizona Onyx Manufacturing Co.

Several small operations, one of which is known as the Brown Onyx Quarry, are worked at times near Flagstaff, Coconino County.

California. - A number of deposits of onyx marble have been reported in California, but most of them are too small to be of commercial importance.

A quarry at Suisun City, Solano County, at intervals furnishes a stone varying from light amber to deep resinous brown.

White, gray, and greenish onyx have been reported also from southern San Bernardino County. The Morongo Onyx Co. has made shipments via Whitewater.

A deposit which furnished material in substantial quantities about 30 years ago is located in San Luis Obispo County near Musick. The stone is quite variable in color, close in texture, translucent, and takes a high polish. Blocks 3 to 6 feet square were taken from the quarries. Specimens of the

Generated on 2024-09-17 14:37 GMT / https://hdl.handle.net/2027/osu.32435030644116
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

material are on exhibit in the museum of the California State Mining Bureau.

In 1934 a small production of onyx was reported from Porterville, Tulare County, but there has been no activity since that date.

Montana. - A vein of onyx 65 feet wide, about 5 miles north of Manhattan, Gallatin County, has been developed to some extent by the Northwestern Improvement Co. (St. Paul, Minn.) and sold as "Montana onyx." The stone has an attractive vertical-banded structure. It polishes well and presents many beautiful patterns. The deposit has been described in some detail by Mansfield.3/

A silicified banded ornamental rock, also known as "Montana onyx," occurs about 20 miles southwest of Virginia City, Madison County.

New Mexico. - Onyx marble has been produced near Rio Puerco, Valencia County, and near Columbus, Luna County.

South Dakota. - A deposit estimated to be 300 feet wide and 1,500 feet long is reported in the Black Hills near Custer.

Utah. - An onyx deposit classed as aragonite in the vicinity of Grantsville, Tooele County, is worked by Byron E. Townsend, Jr., chiefly for production of poultry grit, terrazzo, stucco, and whiting substitute, but select blocks that are sound and highly ornamental are sold for the manufacture of novelties.

Onyx has been quarried at Pelican Point on the west shore of Utah Lake, Utah County. The stone is of dark and light amber shades and has been described as being beautifully translucent and having colors of great depth and brilliancy. It was used in the interior of the City and County Building, Salt Lake City. A deposit at Lehi in the same county furnished bright lemon and orange, dark-buff, chrome-yellow, and white slabs.

Wyoming. - The Jay Em Onyx & Gem Co. began development of an onyx deposit near Jay Em, Goshen County, in 1939. Manufacture of mantels and other products began in 1940.

Other States. - Onyx marbles also occur in the Eastern Appalachian region of the United States, especially in the cave districts of Virginia. Sometimes these deposits are of sufficient extent to warrant the opening of small quarries, although the stone is rarely of sufficient beauty to compete actively with the onyx marbles of Mexico, Arizona, California, and Montana. A quarry which was once developed at Willowton, Mercer County, W. Va., produced material of a greenish-white color similar to the Mexican onyx.

Several cave deposits near Cave City and Mammoth Cave, Ky., yielded small quantities of material for a number of years. Quarries in the broken-down

3/ Mansfield, G. R., Some Deposits of Ornamental Stone in Montana: Geol. Survey Circ. 4, 1933, 22 pp.

Generated on 2024-09-17 14:39 GMT / https://hdl.handle.net/2027/osu.32435030644116
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

caves of eastern Tennessee, southwestern Missouri, and Arkansas have been worked for limited periods and have furnished material of fair grade.

Uses

Mexican onyx which is available in slabs of considerable size is used to some extent for interior decoration. The larger sizes are used in staircases; for mantels and fireplaces; as moldings and columns; for ornamental wainscoting in hotel lobbies, banks, and theaters; and as panels fronting soda fountains. Table tops and other pieces of furniture are sometimes made of onyx. Much Mexican onyx, as well as virtually the entire output of the United States and Argentine, is used for ornamental products of small size which may be classed in four principal groups - lamp bases, desk sets, clock cases, and novelties. The latter include smoking sets, paperweights, card receivers, bookends, gear-shift balls, and plaques.

In Egypt during very early times onyx marbles were used for making small articles such as jugs, bowls, vases, and urns of different shapes and designs. These articles were used for domestic purposes and in religious rites. Few, if any, were polished, although many show great skill in workmanship. Statuettes of that period carved from onyx may be found in museums. Marble of this type, which was available in slabs 20 feet long, was used also for the decoration of tombs and temples and for construction of shrines. Large blocks or columns of the material likewise were used in buildings. One of the finest pieces of work now on exhibition in a museum in London is an elaborately carved sarcophagus hollowed out of a single piece of onyx marble.

The stone was used by the Romans in much the same way. The remains of an old court flagged with onyx were found in an Arabian mosque built during the twelfth century. References are made to the use of onyx "in the palmy days of the Persian empire" in the form of slabs to pave fountains and baths. Small pieces were used in windows and doors instead of glass. Much of the so-called alabaster of ancient times was onyx marble.

Onyx marble was quarried in Mexico before the time of the Spaniards. The Aztecs used it extensively in the ornamentation of their temples; altars and baptismal fonts were made of it, and thin slabs constituted the window panes.

Production and Imports

So little onyx marble is quarried in the United States that it has never been possible to publish figures of production separate from those of marble.

Import figures likewise are not reported separately, onyx being included with marble and breccia in the statistical reports; however, the principal foreign sources of supply are Mexico and Argentina, and as virtually no imports of other types of marble are reported from these countries the total imports may be regarded as onyx.

Imports from these countries during recent years are indicated in the following table. The high unit value of the Argentine product is noteworthy.

Generated on 2024-09-17 14:43 GMT / https://hdl.handle.net/2027/osu.32435030644116
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Onyx marble (rough blocks) imported into the United States from Mexico and Argentina, 1933-39

Year	Mexico		Argentina	
	Cubic feet	Value	Cubic feet	Value
1933...	--	--	2,955	$54,306
1934...	1,436	$ 5,747	2,411	58,990
1935...	4,158	20,622	3,800	94,378
1936...	8,799	37,499	2,837	72,091
1937...	13,253	56,726	3,250	75,840
1938...	10,443	43,940	3,558	56,030
1939...	11,802	46,612	5,062	54,955

The Tariff Act of 1930 provides duties on onyx and manufactures of onyx imported for consumption in the United States under paragraph 232, as follows:

(a) Marble, breccia, and onyx, in block, rough or squared, only, 65 cents per cubic foot; marble, breccia, and onyx, sawed or dressed, over 2 inches in thickness, $1 per cubic foot.
(b) Slabs and paving tiles of marble, breccia, or onyx; containing not less than four superficial inches, if not more than 1 inch in thickness, 8 cents per superficial foot; if more than 1 inch and not more than 1-1/2 inches in thickness, 10 cents per superficial foot; if more than 1-1/2 inches and not more than 2 inches in thickness, 13 cents per superficial foot; in addition thereto on all the foregoing, if rubbed in whole or in part, 3 cents per superficial foot, or if polished in part (whether or not rubbed), 6 cents per superficial foot.
(c) Mosaic cubes of marble, breccia, or onyx, not exceeding 2 cubic inches in size, if loose, one-fourth of 1 cent per pound and 20 per centum ad valorem; if attached to paper or other material, 5 cents per superficial foot and 35 per centum ad valorem.
(d) Marble, breccia, and onyx, wholly or partly manufactured into monuments, benches, vases, and other articles, and articles of which these substances or any of them is the component material of chief value, not specially provided for, 50 per centum ad valorem.

Reciprocal trade agreements that have come into effect up to the end of 1939 have not changed these tariffs.

Prices

As onyx is ornamental in character and quite variable in quality there are no standard methods of grading it and no regular market quotations. The price may range from $4 to $25 or more a cubic foot depending on color, texture, and size of blocks. Argentine onyx commands a much higher price than Mexican onyx.

Generated on 2024-09-17 14:39 GMT / https://hdl.handle.net/2027/osu.32435030644116
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

TRAVERTINE

Occurrence

Travertine deposits large enough to supply blocks of commercial size are uncommon. Italy has been the chief source of production and has supplied the entire requirements of the United States until the last few years, during which time several deposits in this country have been developed.

Foreign Countries

Canada. - A deposit of travertine near Cochrane, Alberta, was reported in 1935.

Italy. - Travertine appears to have been used in Italy as early as the second century B. C., at first only for ornamental purposes. Later it was employed widely as a building stone.

The principal source of travertine has been the deposits at Tivoli about 16 miles east of Rome. Del Barco near the famous baths of Acque Albule at Bagni, a railway station between Rome and Tivoli, is one of the oldest quarries. It furnished travertine during the days of the Roman Empire.

For several centuries block separation at these quarries was a slow process of cutting hand-picked channels on four sides then sledging up at the floor. The stone is now cut with wire saws into blocks about 10 meters long, 1 meter thick, and 2 to 3 meters high. It has been reported that blocks can be put on cars at Bagni at a cost of about 350 lire a cubic meter and on board trans-Atlantic ships for about 400 lire. In 1929, when this estimate was made, 19 lire were equivalent to about $1. The above costs, therefore, were respectively about 56 and 71 cents a cubic foot. Rock at the western end of the quarry is variegated gray and white, stained in places with iron oxide. In recent years stone of this type has become more popular, whereas formerly the only type used was the more regularly colored rock at the eastern end of the quarry.

The area of available travertine is extensive, and several quarries other than the one described are worked. St. Peters, the greatest cathedral in the world, and the famous Colosseum, the largest theater, begun by Vespasian in A. D. 75 and dedicated by Titus in A. D. 80, were built chiefly of travertine from the Tivoli quarries. During the fifteenth and sixteenth centuries the Colosseum was treated as a quarry where stone was procured for many churches and palaces in Italy, notably the Palazzo di San Marco in Venice and the historic Palazzo Farnese in Rome. Demolition was finally stopped and the structure partly restored.

In recent years large quantities of Italian travertine have been imported for interior decorative and structural uses in America. The Pisani quarry, not far from the Del Barco, supplied travertine for the Pennsylvania Railway Station in New York, a structure which attracted much attention and popularized the use of Italian travertine in this country.

Generated on 2024-09-17 14:40 GMT / https://hdl.handle.net/2027/osu.32435030644116
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Union of South Africa. - A large deposit of travertine near Port St. John, Cape Province, was described in 1935. A small amount of development work was under way, but no subsequent report has been received.

United States

California. - A deposit near Bridgeport, Mono County, said to be of the same texture and quality as the best Roman travertine, was worked some years ago for construction use in San Francisco.

Colorado. - A deposit that compares favorably with the famous Italian travertine has been developed about 6 miles east of Salida, Colo., near the Denver & Rio Grande Western Railway. The deposit forms one side of a mountain which rises 250 feet from the valley floor. The exposure is 1,300 feet long and 200 feet thick. The stone is light buff in color, very attractive in appearance, and is finding wide use in the cities of this country for both interior and exterior building. It is quarried by the Colorado Travertine Co.

Colonna & Co. of Colorado, Inc., operates a quarry near Canon City, Fremont County, and markets the stone under the trade name "Colorosa travertine."

Florida. - A deposit near Bradenton, Manatee County, described as travertine was worked for several years subsequent to 1929 and sold as "Floridene stone." There has been no recent activity in this region.

Georgia. - A quarry operated for a brief period near Cuthbert in southwestern Georgia provided stone of a brown to golden color and a porous structure. It was sold in limited quantities for interior building purposes, and waste material was marketed as chips for terrazzo floors. The product was classed commercially as travertine.

Montana. - A deposit of travertine 1-1/2 miles west of Gardiner, Park County, near the north entrance to Yellowstone Park, was developed in 1932 and has produced considerable quantities of stone sold under the trade name "Yellowstone travertine." The deposit is extensive, and to obtain a variety of colors the operator, the Northwestern Improvement Co., has opened up eight separate quarries. The principal colors are white, buff, pink, red, sienna, rose sienna, and light amber. Like Italian travertine the rock contains numerous holes ranging in size from a pinpoint to 1 inch or more across. Sound blocks 6 to 8 feet long and 3 to 4 feet wide are available. The deposit has been described in detail by Mansfield.4/

Other States. - Certain porous beds in limestone deposits near Winona, Minn., and in other localities are sold as travertine.

Uses

The adaptability of travertine for exterior walls has been proved by its durability in the old Roman buildings. Domestic travertine, particularly that from Colorado, is also used for exteriors, but both the domestic and imported

4/ See footnote 3.

Generated on 2024-09-17 14:40 GMT / https://hdl.handle.net/2027/osu.32435030644116
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

products are employed principally for interior building as flooring and wainscoting or for the walls of lobbies and entrances in large structures such as railway stations, hotels, banks, or other public buildings. The soft luster of travertine gives it decided warmth and renders it especially desirable for such uses. Because of its lightness and strength it is favored for arches and other vaulted structures. It is claimed that travertine improves the acoustics of large rooms or auditoriums. It is especially desirable for floors because it resists abrasion remarkably well, and the holes or voids in the surface tend to make it nonslipping.

In the construction of homes it is employed for fireplaces, doorways, lintels, flagging, and floor tile. Small pieces are in demand for table tops, lamp bases, and novelties. Waste material may be used for manufacture into mosaic tile, terrazzo, and stucco.

Notable examples of the use of travertine are in the interior of the Pennsylvania Station in New York and in the United States Chamber of Commerce Building and the Department of Commerce Building in Washington. In the last-named it is employed for floors of the entrances and main lobby and for the floors and treads of the stairways leading from the main lobby to the basement and to the second and third floors.

Production and Imports

Production figures for travertine are included with those of limestone in the statistical reports of the Bureau and therefore cannot be shown separately.

Imports of travertine, most of which originate in Italy, are shown in the following table which covers the years 1931-39. Figures were not recorded separately for any full year prior to 1931.

Imports of travertine into the United States, 1931-39

Year	Cubic feet	Value
1931....	85,500	$64,521
1932....	37,706	23,583
1933....	13,574	10,133
1934....	5,056	6,849
1935....	17,763	21,498
1936....	48,917	67,185
1937....	13,404	18,677
1938....	29,641	32,313
1939....	28,946	29,211

Generated on 2024-09-17 14:42 GMT / https://hdl.handle.net/2027/osu.32435030644116
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY